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Experiment Station Work, LXV.

Compiled from the Publications of the Agricultural Experiment Stations.

COST OF AVAILABLE NITROGEN.
MANAGEMENT OF MARSH SOILS.
WEEDER HARROW FOR DRY FARMS.
V-SHAPED COTTON-STALK CUTTER.
STORAGE FOR ROOT CROPS.
DANGER IN FEEDING ROOT CROPS.
SANITARY CARE OF SWINE.
INDIVIDUALITY OF THE COW.
HATCHING AND REARING TURKEYS.

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PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.

A. C. TRUE, Director.

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EXPERIMENT STATION WORK.

Edited by W. H. BEAL and the Staff of the Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. TRUE, Director, Office of Experiment Stations.

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EXPERIMENT STATION WORK.[1]

COST OF AVAILABLE NITROGEN.[2]

E. B. Voorhees shows in a bulletin of the New Jersey Experiment Stations that 40 per cent of the total amount annually expended for fertilizers in that State is paid for nitrogen, and this is probably typical for all regions where fertilizers are generally used. Moreover, nitrogen is the only one of the three essential elements of plant food likely to suffer any considerable loss in use, not more than 70 per cent of the nitrogen applied in the best forms being recovered in crops. There are no such losses of phosphoric acid and potash.

From the standpoint of crop it is evident that the utilization of nitrogen is a much more important matter than the use of phosphoric acid and potash, although the further fact that a pound of nitrogen, capable of being used in a commercial fertilizer, and without regard to form, costs from four to five times as much as a pound of "available" phosphoric acid or of potash, is an additional argument in favor of greater care in its purchase and use.

Nitrogen as nitrate is the only commercial form soluble in water, ready for immediate use by most plants. Nitrogen as ammonia is also a form soluble in water, but it is less available than the nitrate. A pound of nitrate and a pound of ammonia, being definite chemical compounds, are quite as good from one source as another.

Organic forms of nitrogen have to decay first, changing to ammonia and then to nitrate, and are therefore less quickly available; besides, they vary in their rate of availability according to the source of supply and their physical character. Materials which are likely to decay quickly, as dried blood, dried meat, dried fish, and cottonseed meal, do show a high rate of availability, while forms like ground leather and ground peat show a very low rate of availability. A pound of organic nitrogen varies in availability, therefore, according to its source, whether derived from dried blood or peat or from intermediate products.

Since nitrogenous materials are variable in their rate of availability—that is, the rate at which the nitrogen in them may be absorbed by the plant—the farmer desires to know the dependence that can be placed on the different materials. He wants available nitrogen. Hence, the chemical and physical characteristics of the various forms of nitrogen have been made the subject of very consider-

[1] A progress record of experimental inquiries published without assumption of responsibility by the department for the correctness of the facts and conclusions reported by the stations.

[2] Compiled from New Jersey Stas. Buls. 221, 224; Rhode Island Sta. Buls. 142, 143.

able study and investigation, in order that at least approximate values in respect to availability may be attached to each form. Sufficient work has been done thus far to establish a pretty safe relationship between the nitrate, ammonia and organic nitrogen, in the form of dried blood.

The results of comparative experiments by the New Jersey Station show "that the recovery for nitrogen as nitrate was 62.09 parts per hundred; for the nitrogen as ammonia, 43.26 parts per hundred; and for organic (dried blood) nitrogen, 40 parts per hundred."

With the returns from nitrate, the highest recovery regarded as 100, the relative availability of the nitrogen as ammonia would be 69.7 and of nitrogen as dried blood 64.4.

These figures possess a very great practical significance, as they have a direct bearing upon the economical purchase and use of the nitrogen contained in the fertilizers now offered upon the market.

Commercial conditions fix the price of the various nitrogenous materials, and the cost to the farmer of any one form is not measured by its usefulness to him, but by the cost in the market. That is, there is no strict relationship between commercial and agricultural values.

It happens that at the present time a pound of nitrogen in the form of nitrate or of ammonia costs the farmer less than a pound of organic nitrogen; that is, the nitrogen possessing the highest rate of availability as nitrate is less expensive to him than dried-blood nitrogen, or even that derived from low-grade nitrogenous materials, which do not possess any definite rate and which must, on the average, show a much lower rate of availability than dried blood, because the mixtures contain nitrogen derived from many sources, not uniform in their content of nitrogen or in their physical character or constitution.

The experiment station has since its establishment consistently urged the farmers, in their purchase of fertilizers, to be guided not only by the quantities of the constituents present in the mixtures offered, but also by the kind that is used in them, pointing out the importance of selecting brands which contain high percentages of available plant food, more especially of nitrogen, because of its relatively greater importance or its higher cost.

The station does not discourage, but strongly encourages, the use of waste products containing nitrogen, but it insists that—

The cost to the farmer of a pound of nitrogen in these materials, of a value lower and more variable than the nitrate and ammonia, should be lower rather than higher than for nitrate or ammonia.

It is not economy to save refuse nitrogenous materials if the cost of the nitrogen to the farmer is greater and his returns less than may be obtained by the use of nitrogen from materials of known value. Farmers have been and are now spending thousands of dollars for nitrogen for which they do not receive a proportionate return.

To the farmer it is purely a business proposition. He buys nitrogen in order that he may get a return in crop. If in one case 100 pounds of nitrogen contributes 60 pounds to the crops upon which it is applied and in another 100 pounds contributes but 40 pounds to the crops, the purchaser should not pay the same for the second as for the first, for if he did so he would pay 50 per cent more per pound for his "available" nitrogen. That is, if the cost of the first hundred pounds were $15, the second hundred should cost but $10 when the basis of value is the amount available in each.

MANAGEMENT OF MARSH SOILS.[1]

The agricultural value of marsh or swamp lands has long been realized and it is generally recognized that their successful reclamation will add enormously to our national wealth as well as improve the sanitary conditions of the immediate and surrounding country.[2] In a bulletin of the Wisconsin Experiment Station A. R. Whitson and F. J. Sievers give valuable information on methods of draining, cultivating, and fertilizing such soils based upon observations and experiments in different parts of the State.

In draining extensive areas the construction of large main ditches requiring the use of a dredge will be necessary. In such cases cooperation among the adjoining owners is recommended either by organizing a drainage district or by having the town or county officer take charge of the work. With smaller areas this can usually be done by mutual agreement between two or three adjoining owners.

Two kinds of drainage must be provided for—first, surface drainage, and second, subsurface drainage. It is occasionally true that the construction of ditches around the edge of a marsh tract in such a way as to carry off most of the water from the surrounding higher land without letting it onto the marsh will reduce the wetness of the marshland to such an extent that crops can be grown without further ditching. Ordinarily, however, ditches on the marsh itself are necessary.

The necessity for subdrainage either by deep open ditches or tile depends very largely upon the character of the subsoil and its relation to the surrounding land. When subdrainage is necessary, the use of tile makes it possible to do away with open surface ditches and so greatly facilitates the operations of cultivation. Nevertheless, the muck and peat of marshlands usually shrinks and settles considerably on drainage, making it often desirable to leave open ditches for three or four years until this shrinking has taken place, after which the ditches may be cleaned out and tile laid and covered.

On some marshes, particularly those covering considerable areas where the marsh soil is coarse fibrous peat and underlaid at relatively shallow depths by coarse sand, it is possible that too thorough drainage may occur, so that crops on such land during very dry seasons may suffer for lack of water. Under such conditions it is quite probable that the use of dams at intervals in the mains and larger lateral ditches for holding back the water during very dry seasons will be found advantageous.

Where a deep growth of sphagnum moss occurs it is usually difficult or impossible to plow properly before this has been removed, and the only practical method for this purpose seems to be that of burning.

While it is ordinarily not considered desirable to burn soils more than is absolutely necessary, in such cases as this it can not be avoided, and there is much less objection to burning on marsh lands than on uplands, provided only so much of the surface is burned as is necessary to permit of good breaking. Indeed, the ash from this shallow surface burning adds greatly to the fertility

[1] Compiled from Wisconsin Sta. Bul. 205.
[2] See U. S. Dept. Agr. Farmers' Buls. No. 78, p. 7; No. 320, p. 9.

of these lands for the first few years. Where the moss has considerable depth and on boggy marshes it can only be burned during a dry season and in the hot summer period of July and August. Great care must, of course, be used to prevent the spread of fire under such conditions.

Whether burning is necessary or not, the summer and early fall is the best time for the plowing of such lands. Where the soil is of a mucky character a good stubble plow can ordinarily be used successfully. Where, however, the soil is peaty, a good breaking plow with very long mold board must be used, and the larger the plow the more successfully can the furrow slice be turned. For this reason the use of a large steam plow on such lands is very successful. Moreover, the great weight of such a plow is extremely beneficial to pack the soil so as to secure a firmer seed bed. This compacting of the peaty soil doubtless hastens its rotting and the necessary chemical decomposition to produce fertility, while it also firms the soil, thus greatly improving its texture as a seed bed, especially for cereals. These crops ordinarily do best on rather close soil, such as clay or clay loam, and the more nearly marsh soils can be brought into that condition the better will they be adapted to their culture. This, of course, must not be understood as meaning that marsh lands which are merely wet clay soils, even though they do contain considerable black and entirely decomposed organic matter in the form of humus, should be treated in this way. Such soils are often too compact and close and should be left in the rough furrow slice during the winter so as to allow the action of the frost after drainage to produce the granulation so necessary to a good tilth on such lands.

In chemical composition marsh soils were found to differ from upland soils chiefly in having a large amount of nitrogen and usually a relatively smaller amount of phosphorus and potash. In limestone regions the lime from subsoil and rock is dissolved out by the waters percolating through the soil so that these marshes are not acid.

In soils like these where there is at most a deficiency of one or two elements only and almost an oversupply of nitrogen, it would not seem wise to use a complete fertilizer containing large quantities of the three essential plant-food elements. Barnyard manure, which contains a liberal supply of nitrogen, should therefore not be used on marsh lands, when the farmer has upland soil on his farm that needs a complete fertilizer. The amount of phosphorus and potash in 15 tons of barnyard manure, valued at about $1.50 per ton, can be applied in the form of potassium chlorid and rock phosphate at a combined cost of $7 per acre. This means a saving of about $15 per acre in fertilizer, besides the extra labor necessary to apply the manure.

Results of experiments showed a great variation not only in the total amount of phosphorus, but also in the readiness with which plants can extract that which does occur in the soil. Only by using phosphate fertilizers could satisfactory crops be grown. One of the most important factors influencing the solubility of phosphates in marsh, as well as in other soils, is the presence or absence of acid, acid soils as a rule being low in available phosphorus.

The cheapest form of phosphate fertilizer is the untreated ground rock phosphate, known as floats. This material is extensively mined in Tennessee and contains from 25 to 28 per cent of phosphoric acid (P_2O_5). It is not readily available to crops on some soils and is, therefore, very extensively treated with sulphuric acid to form acid phosphate, which is soluble and avail-

able to crops on all soils. The sulphuric acid, however, and the labor involved are expensive, so that where the natural rock phosphate can be used it is very much cheaper. The large amount of organic matter in marsh soils and its decomposition after drainage makes possible the use of untreated rock phosphate, which is acted on by the organic acids of the soil so as to cause it to become available. Nevertheless, it is well to make a rather heavy application at first since there is little danger of loss of phosphorus, and some time is necessary for it to become available. A half a ton per acre for the first application and followed by 400 to 600 pounds each three or four years thereafter is sufficient to supply the needs of heavy crops.

Ground steamed bone meal is also an excellent phosphate fertilizer for such lands, though much more expensive than the natural rock phosphate. Smaller quantities, however, are used at first than with the other form. From 300 to 500 pounds may be used at the beginning and each three to five years thereafter.

With most marsh soils the use of some form of potash fertilizer was found necessary to the maintenance of fertility. Either the muriate or sulphate of potash is recommended, the former being somewhat cheaper, and, except for certain crops, equally as good as the sulphate. Potatoes, tobacco, and sugar beets, however, have better quality when the sulphate is used.

Both these fertilizers are quite soluble so that it is unnecessary to make a larger application in the beginning as in the case of the rock phosphate above mentioned. The amount used, however, will depend upon the crops to be grown. Such rank-growing crops as beets and cabbage should have from 250 to 300 pounds of this fertilizer per acre; corn and potatoes, 150 pounds; and cereals and hay grasses, 100 pounds per acre. When these crops are grown in rotation it may be unnecessary to use the potash fertilizer in seeding down with a cereal crop following a crop on which a heavy application was used the previous year.

These fertilizers may be applied at any time and should ordinarily be spread broadcast and either plowed in, disked, or harrowed in so as to have them well distributed through the soil. On account of the small bulk of the fertilizer used, it can be applied readily by hand, in seeding grain or it may be mixed with the phosphate fertilizer when this is applied and distributed in one of the many fertilizer distributers on the market.

Where marsh soils were shallow and underlain by clay the potash content seemed to increase after a few years of cultivation—that is, a part of the necessary potash became available from the subsoil, whereas the need of nitrogen and phosphorus gradually developed, so that a complete fertilizer such as barnyard manure would be most helpful. Wood ashes gave very beneficial results on decidedly acid soils, the alkalinity of these ashes evidently causing the peat to decay more rapidly, thus furnishing available nitrogen.

A WEEDER HARROW FOR DRY FARMS.[1]

One of the prime requirements for successful dry farming is effective tillage implements which accomplish the greatest results

[1] Compiled from Utah Sta. Bul. 112; Deseret Farmer, 6 (1910), No. 33, p. 4; Transvaal Agr. Jour., 9 (1910), No. 33, p. 78; Dry Farming, by J. A. Widtsoe (New York, 1911, p. 313).

with the least expenditure of labor. A homemade implement (fig. 1), which has been found very effective in dry farming in Utah, taking the place in a measure of the harrow, disk leveler, and weeder, is described by J. C. Hogenson, of the Utah Experiment Station, as follows:

The implement consists of a rectangle, 10 by 4 feet, made of 2-inch planks, 8 inches wide. To the under side of the 10-foot planks are bolted nine knives made from ¼-inch steel, 24 inches long. The steel is bent 8 inches from one end so that it will drop down behind the plank. The knives are bolted to the plank diagonally at an angle of 45° by means of two bolts. The bend is about 3 inches deep, which allows the knives to work that distance below the surface of the ground. The long part of the steel below the bend is sharpened on the front side so that weeds will be cut, this blade being about 13 inches long. The knives on the front slope to the right, while those on the rear plank slope to the left. This arrangement makes it impossible for any weeds to be missed, or any part of the ground to remain unstirred. The framework levels the land and crushes the clods, while the knives destroy the weeds and loosen the ground to the depth of 3 inches and form a perfect mulch.

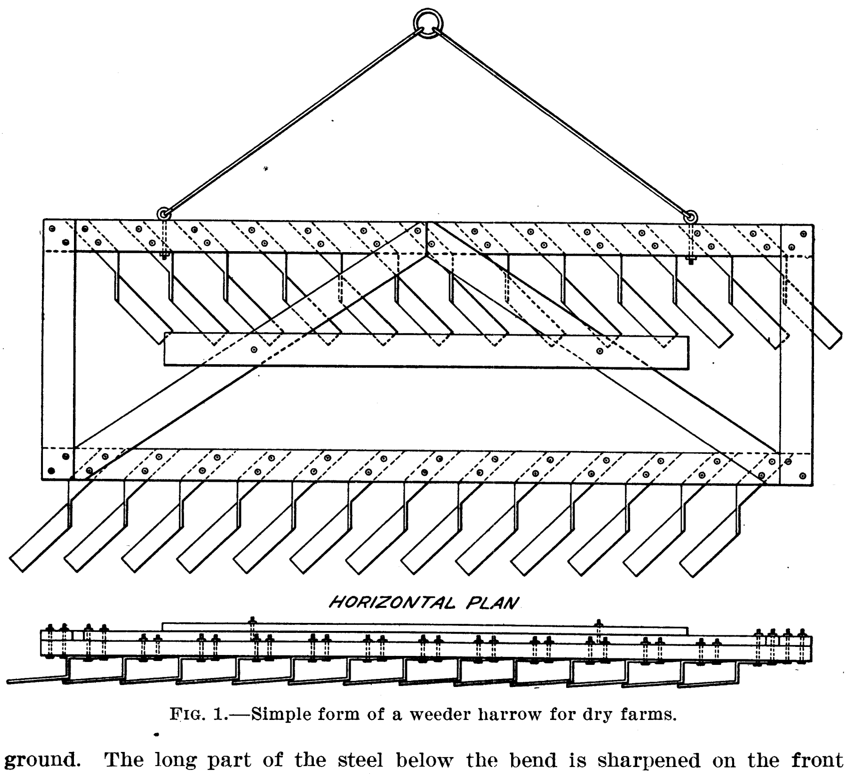

FIG. 1.—Simple form of a weeder harrow for dry farms.

An improved form of this implement (fig. 2) is described by Prof. Hogenson as follows:

The frame of the implement is made of 4-inch channel steel, 6 by 4 feet. The frame is not made solid, but the 6-foot pieces are fastened to the 4-foot pieces by means of bolts so that the 6-foot pieces can turn freely. To make the

frame more solid, two iron-rod braces run diagonally from the front part of one 4-foot piece to the back part of the other. The weeder knives, 14 in number, are made of medium hardened steel, 3 inches wide by $\frac{1}{4}$ inch thick. Each knife is 22 inches long and is fastened to the 6-foot pieces at an angle of 45° by means of two bolts. Just behind the 6-foot piece a 3-inch bend is made in the knife, allowing it to drop horizontally below the frame. The front edge of the knife is sharpened. The knives on the front part of the frame, seven in number, slope to the right, while those on the rear part of the frame, seven in number, slope to the left. A lever attachment connects the two 6-foot pieces so that the knives can be raised or lowered at will. One $1\frac{1}{4}$-inch steel axle, 6 inches in length, is bolted to the inside of each of the 4-foot pieces so that when wheels are put on and the man is riding the machine is perfectly balanced and off the ground. Wheels are used only for transporting the implement to the field. The wheels are 18 inches in diameter with a $4\frac{1}{2}$-inch face. The seat is placed on a bent spring on the 4-foot piece, to which the lever is attached.

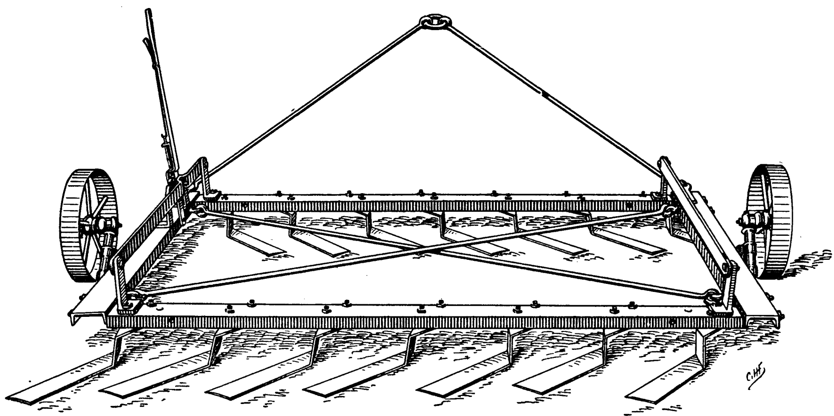

FIG. 2.—An improved modification of the weeder harrow.

Two horses can pull the implement readily. The doubletree is fastened to a ring, to which two iron rods coming from the front ends of the 4-foot pieces are attached. For summer-fallowed ground two of these implements can be run side by side, drawn by four horses, and manipulated by one man.

THE V-SHAPED COTTON-STALK CUTTER.[1]

The wisdom of destroying cotton plants early in the fall in the clean-culture method of combating the boll weevil [2] is generally admitted, but planters often fail to do this in the belief that it is an expensive operation, likely to interfere with other pressing farm work. W. Newell and M. S. Dougherty, of the Louisiana crop pest commission, describe a cheap and effective homemade implement which makes it possible for one man and two horses to cut, windrow, and burn

[1] Compiled from Crop Pest Com. La. Circ. 30.

[2] U. S. Dept. Agr., Farmers' Buls. 344, p. 18; 457, p. 11.

10 to 15 acres of cotton stalks per day, at a cost of from 25 to 35 cents per acre on uplands and from 35 to 50 cents per day on alluvial lands. This implement, known as the V-shaped cotton-stalk cutter (figs. 3 and 4), has been in general use for several seasons in different sections of Louisiana. It may be made at home from the following materials:

2 pieces lumber, 4 by 4 inches, 9 feet long.
2 pieces lumber, 4 by 4 inches, 5½ feet long.

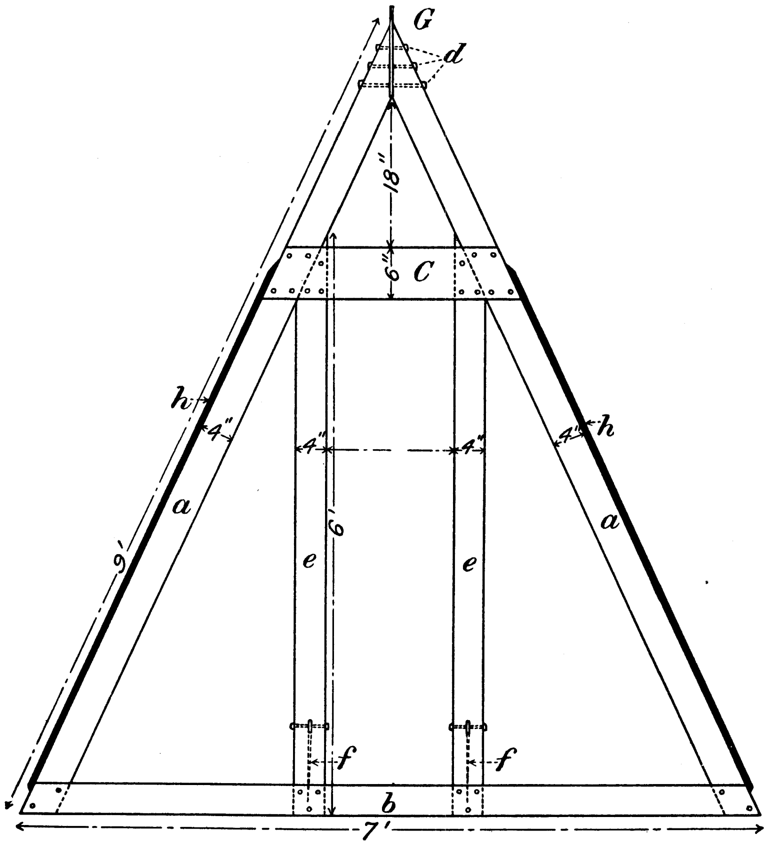

FIG. 3.—The V-shaped cotton-stalk cutter, top view.

1 piece lumber, 4 by 4 inches, 7 feet long.
1 piece lumber, 2 by 6 inches, 3 feet long.
1 piece of iron, ⅜ inch by 2 inches, 30 inches long.
2 pieces of iron, ⅜ inch by 1½ inches, 24 inches long.
12 bolts, ⅜-inch, 6½ inches long.
10 bolts, ⅜-inch, 4½ inches long.
1 bolt, ⅜-inch, 4 inches long.
1 bolt, ⅜-inch, 7 inches long.
2 bolts, ⅜-inch, 9 inches long.
45 bolts, ¼-inch, round heads, 4½ inches long.

45 large washers to fit the $\frac{1}{4}$-inch bolts (needed if the blades are to be made from crosscut saws, as indicated below).

2 steel blades, about $\frac{3}{16}$ inch thick, 3 to 4 inches wide, and 6 to 7 feet long, sharpened on one edge (or, better, two old crosscut saws from which to make the blades).

Only sound, well-seasoned cypress should be accepted. As the six pieces required contain about 50 board feet, the cost for lumber is usually about $1. The bolts required cost about 80 cents, the iron for making the clevis and rudders about 50 cents, and the steel blades about $1 each. If old saws are readily obtainable, they may be used and the price of the blades saved. The total cost for materials will, therefore, range from $2.30 to $4.30, depending on the variable local prices of lumber and hardware, and whether new material must be purchased for the blades. If the farmer has no forge it may be necessary to add the charges of a blacksmith.

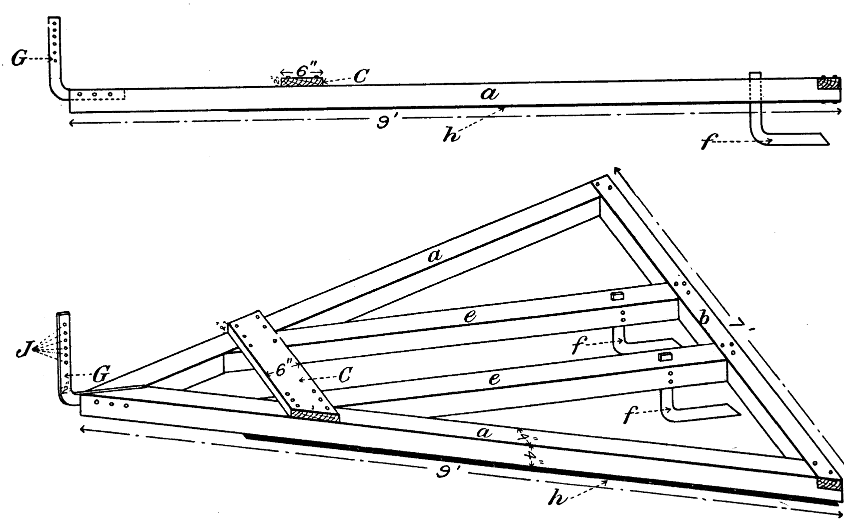

FIG. 4.—The V-shaped cotton-stalk cutter, side view and perspective.

The two 9-foot pieces of cypress (*aa*) and the 7-foot piece (*b*) should be cut and bolted together as indicated in figures 3 and 4. Before they are bolted together an opening should be chiseled in the top of the longer piece to receive the clevis attachment at *G*.

The clevis attachment is made by bending at right angles a piece of iron $\frac{3}{8}$ by 2 by 30 inches. It is bent edgewise about 12 inches from one end. Three holes should be drilled 2 inches apart in the 12-inch arm to receive the 4, 7, and 9-inch bolts (fig. 3*d*) which fasten together the two 9-foot pieces of cypress (*aa*). Six $\frac{1}{2}$-inch holes $1\frac{1}{2}$ inches apart should be drilled in the upper portion of the 18-inch arm of the attachment clevis for use in hitching to the cutter and in regulating the depth at which the blades cut.

The rudders (*ff*) should be made of iron pieces $\frac{3}{8}$ by $1\frac{1}{2}$ by 24 inches, bent at right angles 8 inches from one end in the same manner as the clevis. The outer edge is beaten thin to cut through the ground without unnecessary friction. Six holes 1 inch apart should be drilled in the 16-inch arms of the rudders to permit them to be raised and lowered as the height of rows in the field varies.

The blades (*hh*) should be 6 or 7 feet long and wide enough to bolt firmly to the underside of the 4 by 4 pieces (*aa*) and still extend the cutting surface $1\frac{1}{2}$ inches outside the wood. They should be of well-tempered steel. Old crosscut saws with the smooth edge filed to sufficient sharpness make excellent blades when securely bolted on.

When the side pieces (*aa*) and the base (*b*) are bolted together with $\frac{3}{8}$-inch bolts, the clevis attachment should also be bolted in place. Additional bolts back of the clevis will add to the rigidity of the cutter. The 3-foot piece of 2 by 6 cypress (*C*) should next be bolted to the side piece (*aa*) and the $5\frac{1}{2}$-foot piece (*ee*) bolted to it and mortised into the base (*b*), as indicated in figures 2 and 3. These are the rudder timbers and should contain openings about a foot in front of the base (*b*) of suitable size to receive the 16-inch rudder arms (*ff*). Two bolts through each rudder and rudder timber should hold the rudders in place. When in addition to these steps the blades (*hh*) have been securely bolted to the undersides of the side pieces the machine is completed. The blades should project $1\frac{1}{2}$ inches and extend to the rear corners of the machine. If the blades are curved because made from crosscut saws, or from any other reason, they should be so set as not to project more than $1\frac{1}{4}$ inches to $1\frac{1}{2}$ inches at the centers. In any case plenty of bolts should be used and absolute rigidity secured.

The stalk cutter is sometimes constructed with but one rudder and rudder timber. In this case the rudder is in the center of the machine, and runs half way between the rows where the ground is usually hard. It does not go deep enough to hold the machine steady and the lack of weight also contributes to unsteadiness. The two-rudder machine with the rudders running in the soft dirt at the sides of the rows go in deep enough to prevent skidding.

In using the cutter it is necessary to keep the blades very sharp by filing or other means. They should be so adjusted as to cut the cotton stalks at or just beneath the surface of the earth. Their depth is regulated by raising or lowering the chain by which the singletree is attached. If the machine runs too shallow the attachment should be raised to a higher notch in the attachment clevis (*J*, fig. 4). The rudders should be set deep enough to prevent skidding, but not deep enough to make the machine pull too heavily.

Where no fence surrounds the field two horses or mules should be hitched tandem to the stalk cutter in order that both may walk in

the middle and pull steadily. If the field is fenced this arrangement will prevent cutting of the stalks at the ends of the rows and the two horses must be driven abreast. It is absolutely necessary that not a single green cotton stalk be left uncut in the field or at its edge if the weevils are to be starved. For this reason the field should be carefully gone over and every stalk that the machine has missed should be cut with a sharp cane knife.

STORAGE FOR ROOT CROPS.[1]

E. J. Delwiche, of the Wisconsin station, makes the following recommendations regarding the storage of roots for feeding purposes:

The best place to store roots is in a root cellar near where they are to be fed. Such a cellar may be a part of a barn, basement, or it may be built conveniently near to the stock barn. In most places the root house can be built most economically of concrete. Ordinarily cement is the only material that has to be purchased. The gravel and sand are usually available at no

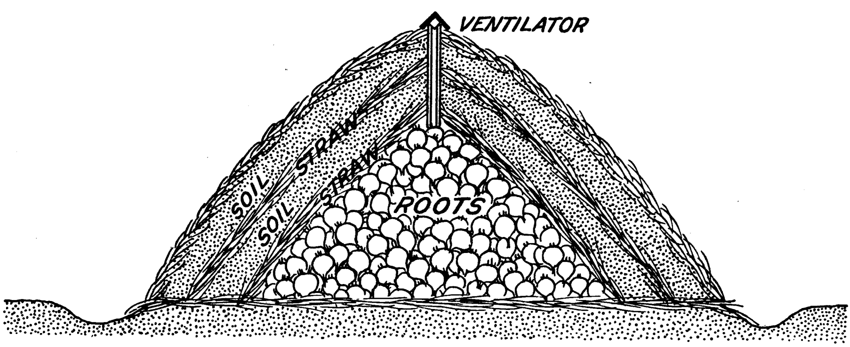

FIG. 5.—Cross section of an easily constructed pit for roots.

great distance on most farms. While the temperature in a root house should never fall to the freezing point, it should be at a low point for best results in keeping roots.

When no cellar is available, roots may be stored in pits. For fall and early winter feeding they need not be covered to any great depth. The roots are put in a conical pile about 4 feet in diameter on a bed of clean straw, then covered with a layer of 2 inches of long straw. Clean rye straw is preferred for this purpose. The straw at the apex of the pile is made to form a chimney 5 or 6 inches in diameter for ventilation. Dirt is thrown on the pile to a depth of 6 inches. The roots are piled as high as possible so as to shed water. When wanted for feeding the whole pit is taken into the barn at once. For early winter feeding the layer of dirt should be thicker, and in addition a covering of straw or horse manure should be placed over the whole pile.

Figure 5 illustrates a pit intended to remain over winter. This provides for two layers of straw and two of earth. A ventilator made of 4-inch boards is placed at the apex. When severe freezing weather sets in, the ventilator is stuffed tightly with fine hay. In such a pit roots will keep without freezing

[1] Compiled from Wisconsin Sta. Circ. Inform. 16.

even in the coldest winters. If desired, the piles may be made oblong instead of conical in shape, retaining the gable form. While pits do very well, so far as keeping the roots is concerned, it must be understood that they are but makeshifts at best. A root house which is accessible at all times is much more satisfactory and more economical in the long run.

A DANGER IN FEEDING ROOT CROPS TO BREEDING ANIMALS.[1]

The value of root crops for feeding farm stock is generally recognized, and their more extensive use in this country for this purpose is often advocated, but investigations carried on by L. G. Michael at the Iowa station suggest that caution should be exercised in the feeding of sugar beets and mangels to breeding animals, and that there is a sound basis for the opinion long held by stockmen "that

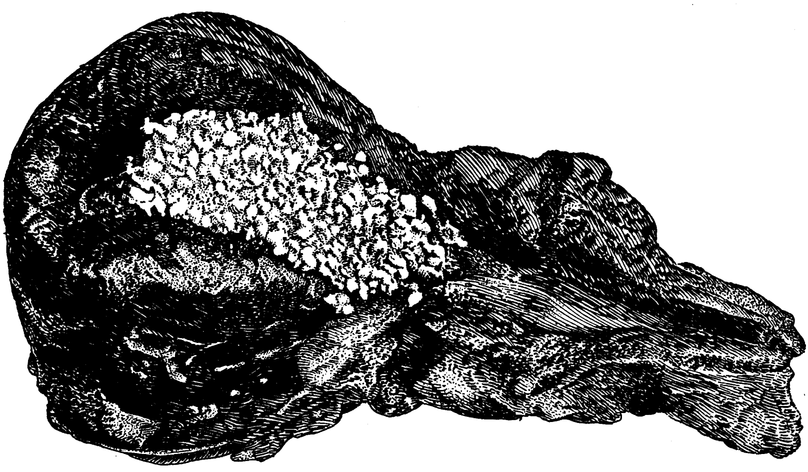

FIG. 6.—Bladder of ram containing many small calculi.

sugar beets and mangels when fed to breeding animals will in some way cause the formation of renal and urinary calculi, or kidney and bladder stones." In a series of experiments with rams extending over five years it was found that "sugar beets and mangels favor the formation of renal and urinal calculi, or kidney and bladder stones, when fed to breeding rams" (figs. 6 and 7), and it is thought "very probable that these roots have the same effect when fed to ewes or to cattle." In view of the fatal results often attending the formation of these stones it is deemed inadvisable to feed sugar beets and mangels to breeding animals, but there appears to be no particular danger in feeding these roots "to fattening animals, as the calculi are not likely to develop sufficiently during the fattening period to cause serious results."

[1] Compiled from Iowa Sta. Bul. 112, popular ed.

SANITARY CARE OF SWINE IN THE SOUTH.[1]

In a bulletin of the Virginia station, Dr. N. S. Mayo states that "swine raising promises to be one of the most extensive and profitable branches of animal husbandry in the South." He points out, however, that "at the present time large quantities of hog products are imported from other sections of the United States to supply the needs of the South." Climatic and seasonal conditions are especially favorable for the cheap production of pork of fine quality in many parts of the South, Dr. Mayo's statement applying particularly to that part of Virginia lying east of the Blue Ridge Mountains.

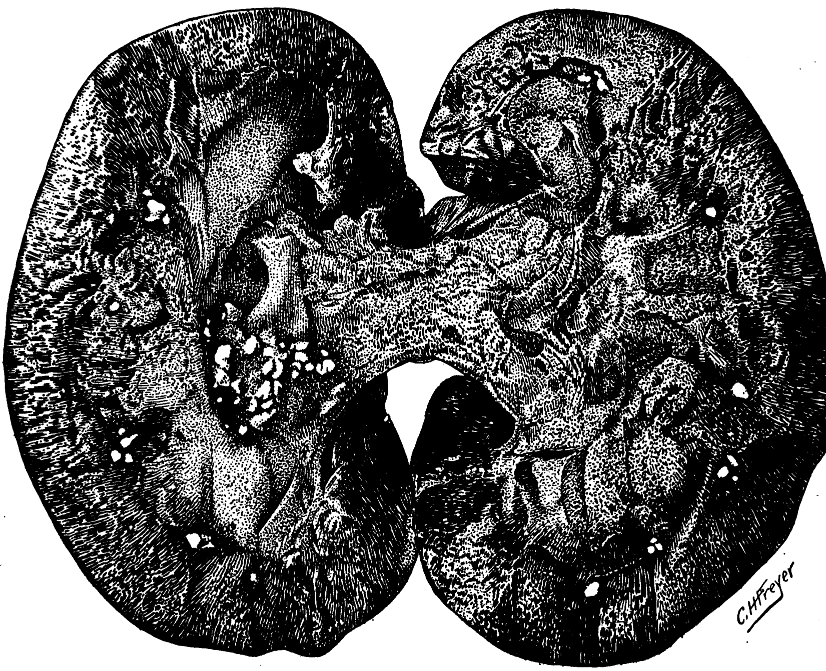

FIG. 7.—Kidney of ram showing presence of calculi.

SIMPLE SANITARY PRECAUTIONS.

There is no question as to the production of an abundance of cheap food, but as Dr. Mayo points out—

In the successful raising of swine there are problems, other than that of feeding, which often determine success or failure. The most important of these is the preservation of the health of the swine. Wherever a considerable number of animals are gathered together the risk from disease is considerably increased. Extra precautions must then be taken to guard against disease and to keep the animals in thrifty condition.

[1] Compiled from Virginia Sta. Bul. 189.

The first essential is that their quarters be kept clean and sanitary.

In purchasing swine, care should be taken that they come from herds free from transmissible diseases, that they are healthy, and have not been exposed to disease in transit. Public stock yards are liable to be infected with hog cholera; it is dangerous to bring swine from such places and put them in a healthy breeding herd.

It is an excellent plan to have a quarantine pen some distance from all other swine, and so located that there is practically no danger of transmitting diseases to the herd. All recently purchased animals should be held in quarantine in such a pen for ten days, to be certain that they are free from disease, before placing them in a healthy herd.

If a disease of swine occurs in the neighborhood, keep away from these farms and do not allow anyone who has been on an infected farm to visit your herd. If your swine have access to a stream of running water and disease appears on a farm located above yours, on the same stream, remove your hogs at once, as the infection is liable to be carried by the stream. Dogs and buzzards also are liable to carry the infection of hog cholera and should be kept away if possible. Such measures are simple, but they are very important.

RANGE FOR SWINE NECESSARY.

While a few swine can be raised confined in limited quarters, if such quarters are kept clean, they will do better, will keep in better health, and can be grown more cheaply if they have plenty of range for pasture. It is desirable to have the pasture fenced off into suitable areas so that the hogs can be shifted from one pasture to another, not only to provide fresh pasture, but also to afford an opportunity to disinfect the pastures, either by plowing and seeding to a forage crop or by exposure to sun and weather. Nearly all cases of intestinal worms, which are rather common in swine, are contracted from infected ground, and swine can be kept free from these parasites by frequent changes of pasture.

INEXPENSIVE SHELTER HOUSES CONDUCIVE TO HEALTH.

On account of the comparatively mild climate of Virginia, swine do not need the elaborate shelter that is necessary farther north. After experience with both permanent hog houses and small portable shelters that can be readily moved from place to place, we consider the small colony houses much superior, so far as maintaining the health of the swine is concerned, and they are also less expensive.

The walled type of hog house shown in figure 8 is well suited to southern conditions.

The walled portable house can be made about 6 feet square, 4 feet high in front, and 3 feet high at the back; a good opening for ventilation and a door 2 feet wide should be left in front. These can be closed by tacking coarse burlap sacks along the upper edge of the openings. The sacks are dropped in severe weather, or to exclude the sun. The roof or top should be removable to facilitate cleaning and to enable a person to enter the pen easily. The back edge of the roof can also be raised for ventilation. Such a pen is large enough for a sow and litter. It can be made larger to meet special needs, but it should not be too large to be easily moved from place to place.

Whichever type of house is used, it should have a good floor that can be easily cleaned and disinfected. In dry weather a dirt floor soon becomes worked up into fine dust that is injurious to pigs when inhaled; in wet weather it is difficult to keep the bed dry.

Bedding for swine should be scant, but of good quality. Forest leaves or corn husks make excellent bedding. Straw soon becomes ground into a dust that is irritating to the lungs and makes the pigs cough. When infected with germs it is liable to cause chronic pneumonia.

All hog houses should be kept clean; they should be thoroughly disinfected every two or three months and a coat of disinfecting whitewash applied.

The nature and treatment of mange, swine lice, bull nose (necrotic stomatitis), chronic pneumonia, hog cholera, and paralysis are discussed. The more common of these troubles are mange, lice, and cholera. For the first, dipping in lime-sulphur dip prepared as follows is advised: Slake 8 pounds of lime with sufficient water to make a thick paste. Sift in 24 pounds of sulphur and mix well with a hoe. "Put this mixture in a kettle with 25 or 30 gallons of water and boil

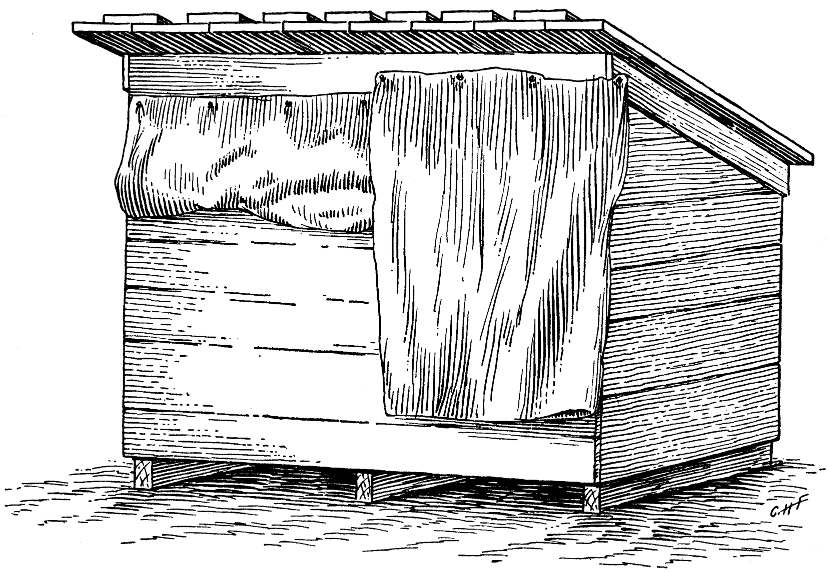

FIG. 8.—A walled portable hog shelter recommended for use in the South.

for at least one hour; two hours is better. When ready for use, add sufficient water to make 100 gallons of dip. * * * This dip should be used warm—100° to 110° F." The dip is applied most effectively by means of a dipping vat.

Dipping vats are made of wood, galvanized iron, or cement. They are set in the ground at a convenient place so that there is good surface drainage away from the vat. A good size for a vat is 10 feet long on top, 8 feet long on bottom, 1 foot wide on bottom, and 2 feet wide on top. The end where the hogs enter should be perpendicular and the other end inclined, with cleats, so that the hogs can emerge after swimming through. The entrance should be by a slide. Such a tank is very useful wherever hogs are kept in numbers, as frequent dipping tends to keep the hogs healthy and free from parasites.

For pigs and small shoats that can be readily handled, a barrel serves the purpose well; the pigs can be caught, plunged in the dip and held there the

required time. Some successful swine raisers build cement bathing places or wallows for swine and keep these filled with a watery solution of some dip or disinfecting solution. If swine have wallowing holes filled with water some of the good dips should be put in these frequently.

After dipping or treating swine they should be placed in clean, uninfected quarters. To disinfect quarters, all litter and dirt should be thoroughly removed and scattered on land not frequented by swine. The floors, partitions, and other parts should be thoroughly saturated with one of the dipping solutions described above. They are best applied by means of a force pump which drives the solution into all cracks. After it is well dried the pens should be whitewashed, care being taken to fill all cracks well. An excellent disinfecting whitewash is made as follows:

An excellent disinfecting whitewash may be made as follows: Slake 25 pounds fresh lime in sufficient water to make a paste, sprinkle in 15 pounds of flowers of sulphur, add 30 gallons of water, and boil for an hour. Then add enough water to make 50 gallons, and apply with a spray pump, using a "Bordeaux" nozzle.

Dipping in coal-tar dips of the creolin type is an effective remedy for lice.

If the hog wallows are kept well filled with water, to which some of the creolin dips are added every ten days, the swine will usually free themselves from the lice. Another good way of combating the parasites is to tie gunny sacks or other coarse cloths around rubbing posts and keep these cloths saturated with crude petroleum.

The nature and treatment of hog cholera is fully dealt with in a Farmers' Bulletin of this department.[1]

INDIVIDUALITY OF THE COW AS A FACTOR IN ECONOMIC MILK PRODUCTION.[2]

Economy in milk production is of prime importance both to the producer and to the consumer. Examples of the wide range in the cost of production, due to a large extent to the individuality of the cow, have been previously given in this series.[3] The cause of this difference in individuality has been studied by the Missouri station, where careful comparisons were made of good and poor cows. Two Jersey cows from the same sire were found to digest their feed equally well, and both required about the same amount of feed for maintenance.

The real cause in the difference in production was found to be in the amount of feed consumed above that required for maintenance. During the year the better cow consumed 3,424 pounds of grain, 2,904 pounds of hay, 8,778 pounds of silage, and 4,325 pounds of green feed. The other cow consumed 1,907 pounds of grain, 1,698 pounds of hay,

[1] U. S. Dept. Agr., Farmers' Bul. 379.

[2] Compiled from Missouri Research Bul. 2; New York State Sta. Bul. 322; Wisconsin Sta. Bul. 191.

[3] U. S. Dept. Agr., Farmers' Bul. 384, p. 16.

5,088 pounds of silage, and 2,102 pounds of green feed. In general the better cow consumed 1.7 pounds of feed for 1 pound consumed by the other cow, and produced 2.67 pounds of milk and 2.77 pounds of fat for each pound produced by the inferior cow. The better cow consumed 3.27 pounds of grain per day for maintenance, and the other 2.92 pounds. Both took hay and silage in the same proportion. The better cow required for maintenance for the entire period 1,200.8 pounds of grain, 1,204.5 pounds of hay, and 4,818 pounds of silage, which left available for milk production 2,233.2 pounds of grain, 1,699.5 pounds of hay, 3,960 pounds of silage, and 4,323 pounds of green feed. The inferior cow required for maintenance 1,065.8 pounds of grain, 1,065.8 pounds of hay, and 4,292.4 pounds of silage, leaving available for milk production 841.2 pounds of grain, 632.2 pounds of hay, 795.6 pounds of silage, and 2,102 pounds of green feed. These figures show the large amount of food left for milk production in the better cow, which was 8,522.9 pounds of milk, containing 5.51 per cent fat. The other cow produced 3,188.9 pounds of milk, containing 5.31 per cent fat.

Data are presented of two other cows kept for an entire lactation period under identical conditions as those above described. * * * The feed consumed during the lactation year minus the estimated maintenance is the amount considered available for milk production. The ratio between the food available for milk production and the milk produced is practically the same with each of the four cows. The available feed consumed and the milk solids produced are also calculated in calories in order to reduce all to a common basis. * * * The main difference between profitable and unprofitable dairy cows is not to be found in the coefficient of digestion, or in the amount of food required for maintenance. A superior dairy cow is simply one with a large capacity for using food above the maintenance requirement and one that uses this available food for milk production.

A further illustration of the difference in the individuality of cows is shown in the records of a herd kept at the New York State station. The best cow in the herd averaged 10,150 pounds of 4 per cent milk annually for three years on $58 worth of food. The poorest cow averaged 3,350 pounds of 5.85 per cent milk on 52.40 dollars' worth of food. If in one year the poorer half of the herd had been replaced by animals equal to those in the better half it would have increased the yearly station revenue $237.40, if the milk had been sold at current shipper's prices, or $379.90 if the milk fat had been sold, with an added expense of only $40, the cost of the extra food consumed by the better cow.

The practice of officially testing dairy cows has proven to be an efficient factor in weeding out the unprofitable members of the herd. The Wisconsin station has published during the year results of official testing in that State for the past 10 years. During the first 5 years of the decade the average production of aged Holstein cows

on a 7 days' test was 397.5 pounds of milk and 13.9 pounds of milk fat, while in the last 5 years of the decade the average production of this class was 432.9 pounds of milk and 15.3 pounds of milk fat. This gain was due in large part to improved breeding, feeding, and selection of the dairy stock.

HATCHING AND REARING TURKEYS BY ARTIFICIAL METHODS.[1]

Notwithstanding the popularity of the turkey for human consumption and its consequent high price, the turkey producers have not been able to supply the demands of the market, due to the fact that turkeys are more subject to diseases than chickens and because the care of the young poults requires much patience on the part of the poultryman. Nevertheless, turkey raising returns a good profit to the producer when properly handled. In Farmers' Bulletin 200 the problems connected with raising turkeys have been outlined and treated more or less in detail. In a previous number of this series [2] precautionary measures for preventing the disease known as blackhead are outlined.

The results obtained in the following experiment, conducted by the Washington station, on hatching and rearing turkeys by artificial methods should prove of value to those who desire information on the care of young poults.

Setting the machine.—About the 1st of June we secured 102 turkey eggs of the Mammoth Bronze variety, which nicely filled the tray of our 150-hen-egg incubator. The machine had previously been warmed in the usual way, and at the time the eggs were placed in the tray the thermometer registered 102°. The moisture pan, which was the same size as the tray and located beneath and 2 inches from the tray, was supplied with sand one-half inch in depth, which was thoroughly saturated with warm water. This sand was kept wet enough to show puddles of water on its surface at all times during incubation, by daily applications of water heated 100 to 103° F.

Turning the eggs.—The eggs were turned once every 12 hours—morning and evening—beginning on the third day after they were placed in the tray and continued until the first sign of hatching, the pipping of the egg. The turning was very carefully done by first removing from the center of the tray about 1 dozen eggs, and then carefully rolling, with the hand, the remaining eggs toward the center of the tray, just enough to change the position of each egg. The eggs that had been removed were then placed in either end of the tray.

Temperature.—During the first week a temperature of 102° was maintained, and afterwards 103°, with but slight variations.

Testing.—On the tenth day the eggs were tested for fertility, 4 clear eggs being found, which, with the 3 that were cracked in transit, left for the machine just 95 eggs. Of these, 4 more were taken out, at the second testing, which occurred on the twentieth day. Thus we had 91 eggs that had stood the test.

Hatching.—The first evidence of hatching occurred on the evening of the twenty-seventh day, and by the evening of the twenty-eighth day the hatch was

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[1] Compiled from Washington Sta. Bul. 96.
[2] U. S. Dept. Agr., Farmers' Bul. 334, p. 27.

complete, resulting in 87 poults—4 had died in the shell. The day following the hatch the incubator door was left ajar about one-eighth of an inch, which was increased the second night to one-quarter of an inch. This was done to gradually harden the poults in their preparation for the hover.

Brooding.—During the afternoon of the second day after the hatch the poults were placed in a hover in the brooder house. The hover had been warmed to a temperature of 90°. The poults appeared well and bright. All were placed in one hover, which proved to be a mistake, for the following morning there were several dead ones, caused by the young things deserting the hover and piling up, many of the underneath ones being smothered. About 30 were thus lost in a few hours.

When reared in the natural way and seeking to be hovered, the poults instinctively duck their heads and creep under the mother hen, while she assumes a settling position. The poults having thus assembled they become distributed among the feathers and under the wings of the hen. The warmth from the hen's body satisfies them. They become quiet. Deprived of the mother hen they bunch when, in their search for warmth, a scramble ensues, each poult making a desperate effort to get under the bunch. In the struggle they become surprisingly entangled, causing a condition that brings death to the weakest ones from smothering.

In order to save the remaining poults they were divided among three hovers, which ended the losses. These hovers were at first kept at about 90° temperature for about a week, when they were reduced in temperature about 10° weekly, until down to 70°, which temperature was maintained until the poults were about six weeks of age, after which time they do not require artificial heat. They were permitted to occupy the hovers for a couple of weeks longer, when the hovers were removed entirely. Care had been taken in keeping the hovers scrupulously clean by removing the dirt and supplying clean chaff. After removing the hovers, the poults were confined to their nursery rooms, each 4 by 12 feet, with an outside runway 4 by 20 feet It was found necessary to provide additional runways as they rapidly outgrew those they were occupying. At four months of age they were given their liberty. They would not range, nor travel but a few rods from the place where they had been confined.

Feeding.—Unlike chickens, the young poults appeared not to know where to find their food. Teaching them to eat promised to become quite a problem. Failing to attract them to their feed in other ways, a few young chicks were placed in the nursery with each flock of poults. It was surprising how aptly they took their first lessons from the chicks. Within one hour the problem was solved and all were feeding and drinking, with no further trouble. The first feed was stale bread, moistened with sweet milk, chopped onion tops, grit, and pure water. At this time the poults were nearly three days old. About three days later their bread feed was gradually changed to commercial chick feed, cooked milk curds, and lettuce. Three or four days later there was added to this feed dry bran and beef scraps—five parts bran to one part scraps—mixed and placed within their reach in shallow boxes, which was kept before them all the time until they became five months of age. A convenient hopper for this dry bran feeding we find to be a box 4 feet long, 6 inches wide, and 6 inches deep, with a strip 2 inches wide, nailed lengthwise and in the middle along the top. Supply this hopper daily, just enough for a single day's feed—all that the poults will eat. Fresh green stuff, such as lettuce, kale, or cabbage, was fed liberally daily, morning, noon, and evening; also sweet milk and fresh water. The drinking vessels were washed clean daily. A box of gravel and cracked

shells and a dust bath were kept in their nursery. From the time they would pick up oats, corn, or wheat their grain ration consisted of equal parts of these grains, mixed and scattered in the runway three times daily, as much but no more than they would eat. We regard that the most surprising thing in connection with the feeding was the small quantity of these grains consumed, which was evidently due to the very liberal supply of milk and green stuff provided.

Preparing for market.—Two weeks before these turkeys were to be marketed for the Christmas trade they were weighed separately, when one-half of the number were divided into lots of four each and placed in darkened pens, admitting the light only at feeding times, while the remaining one-half were confined in roomy roosting quarters, having a runway of 20 by 50 feet. These quarters were not darkened in any way. Both lots, in lieu of the mixed grain and dry bran feed, were fed three times daily of the following fattening ration—all they would eat—making the change gradually: 6 parts corn meal, 2 parts middlings, 2 parts beef scraps, by weight, and moistened with milk. The green feed was fed as before.

This experiment lasted two weeks. The birds that were confined in darkened pens made no gain whatever in weight, while those birds that had more liberty gained 2 pounds and 2½ pounds each. These birds were marketed when a little more than 5½ months of age, when the pullets weighed 13 and 14 pounds each, and the toms 17 to 19 pounds each, live weight.

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